



## Figure skating & angular momentum conservation

During the Winter Olympics and other major figure skating championships, millions of figure skating fans watch their favourite figure skaters perform graceful programs on ice that usually include very rapid spins, which are often combined with jumps. How do figure skaters spin so rapidly?

The key is applying the physics principle of the conservation of angular momentum.

The more rapidly a figure skater is spinning, the greater her angular velocity. The figure skater can also adjust her moment of inertia by controlling how close her mass is to her axis of rotation. By extending her arms and one leg, a figure skater can increase her moment of inertia. By pulling her arms and legs close to her body, she can decrease her moment of inertia.

The figure skater's angular momentum must remain constant according to the law of conservation of angular momentum. As she changes her moment of inertia, her angular velocity must also change so that her angular momentum remains constant.

If a figure skater starts spinning slowly with her arms and possibly one leg extended, she initially has a high moment of inertia and a low angular velocity. If she pulls her arms and leg in closer to her rotational axis, her moment of inertia decreases. Her angular velocity (spinning speed) must therefore increase to keep her angular momentum constant.

When a figure skater wants to slow her spin, she can simply extend her arms again. Her moment of inertia increases, and her angular velocity correspondingly decreases. The figure skater's angular momentum remains constant until she applies an external torque from the ice.

Even if they don't precisely understand the physics involved, figure skaters use the law of conservation of angular momentum to gracefully control their spins and jumps.

(Taken from <http://paul-a-heckert.suite101.com/figure-skating-angular-momentum-conservation-a179794>)

## EXERCISES

### 1 True or false?

- a. Figure skaters must be perfectly conscious of physics to perform their sport. T F
- b. In order to increase their spinning speed the skaters must extend their arms. T F
- c. The physics principle applied in skating is the conservation of angular momentum. T F
- d. A change in the moment of inertia makes the angular velocity change as well. T F

### 2 Complete.

Skaters spin very ..... applying the physics principle of the ..... of angular momentum. When they start ..... with arms, and possibly one leg ....., they have a ..... moment of inertia and a low ..... velocity. To make the moment of inertia ..... they have to ..... arms and leg in ..... to their rotational axis.

As the angular momentum is ..... their spinning speed must .....

*High • rapidly • pull • conservation • extended • increase • Angular • constant • closer • decreases • spinning*

### 3 Match questions and answers.

QUESTIONS		ANSWERS	
A	What happens when the skater changes her moment of inertia?	1	She can do it controlling how close her mass is to the axis of rotation.
B	What happens when the angular velocity of the skater decreases?	2	The skater's angular velocity also changes, so that her angular momentum remains constant.
C	How can a skater adjust her moment of inertia?	3	The moment of inertia increases.
A .....	B .....	C .....	